Technical Documentation

PAM-190-P-A
PAM-190-P-I

Universal power plug for proportional valves

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1 General Information

1.1 Order number

PAM-190-P-A[1] - power amplifier for proportional valves with 0…10 V input in M12-version
PAM-190-P-I - power amplifier for proportional valves with 4...20 mA input in M12-version

Alternative products

PAM-196 - two independent channels for pressure or throttle valves

1.2 Scope of supply

The package includes the power plug (without the M12 counter plug) and the gasket.
This documentation can be downloaded as a PDF file from www.w-e-st.de.

1.3 Accessories

ULA-310 - Programming adapter with USB interface
WPC-300 - Start-Up-Tool (downloadable from our homepage – products/software)
M12-5PS - M12, 5 pin counter plug in screened metal housing

[1] The number of the version consists of the hardware-version (first two digits) and the software-version (second two digits). Because of the development of the products these numbers can vary. They are not strictly necessary for the order. We will always deliver the newest version.

1.4 Symbols used

General information

Safety-related information

1.5 Legal notice

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Date: 01.12.2014

The data and characteristics described herein serve only to describe the product. The user is required to evaluate this data and to check suitability for the particular application. General suitability cannot be inferred from this document. We reserve the right to make technical modifications due to further development of the product described in this manual. The technical information and dimensions are non-binding. No claims may be made based on them.

This document is protected by copyright.

1.6 Safety instructions

Please read this document and the safety instructions carefully. This document will help to define the product area of application and to put it into operation. Additional documents (WPC-300 for the start-up software) and knowledge of the application should be taken into account or be available.
General regulations and laws (depending on the country: e.g. accident prevention and environmental protection) must be complied with.

This equipment is designed for hydraulic applications in open or closed-loop control circuits. Uncontrolled movements can be caused by device defects (in the hydraulic equipment or the components), application errors and electrical faults. Work on the drive or the electronics must only be carried out whilst the equipment is switched off and not under pressure.

This handbook describes the functions and the electrical connections for this electronic assembly. All technical documents which pertain to the system must be complied with when commissioning.

This device may only be connected and put into operation by trained specialist staff. The instruction manual must be read with care. The installation instructions and the commissioning instructions must be followed. Guarantee and liability claims are invalid if the instructions are not complied with and/or in case of incorrect installation or inappropriate use.

CAUTION!
All electronic equipment is manufactured to a high quality. Malfunctions due to the failure of components cannot, however, be excluded. Despite extensive testing the same also applies for the software. If these devices are deployed in safety-relevant applications, suitable external measures must be taken to guarantee the necessary safety. The same applies for faults which affect safety. No liability can be assumed for possible damage.

Further instructions

- The equipment may only be operated in compliance with the national EMC regulations. It is the user's responsibility to adhere to these regulations.
- The device is only intended for use in the commercial sector.
- When not in use the equipment must be protected from the effects of the weather, contamination and mechanical damage.
- The equipment may not be used in an explosive environment.
- To ensure adequate cooling the ventilation slots must not be covered.
- The device must be disposed of in accordance with national statutory provisions.

2 Characteristics

This power plug is used to control proportional valves with one solenoid. The compact and inexpensive solution will be mounted directly on the solenoid.

A typical input signal of 0… 10 V (optional 4... 20 mA) can be used. The output current is closed loop controlled and therefore independent from the supply voltage and a varying solenoid resistance.

The parameterization can be done via the PC interface and the ULA-310 adapter or internally via the UP and DOWN buttons.

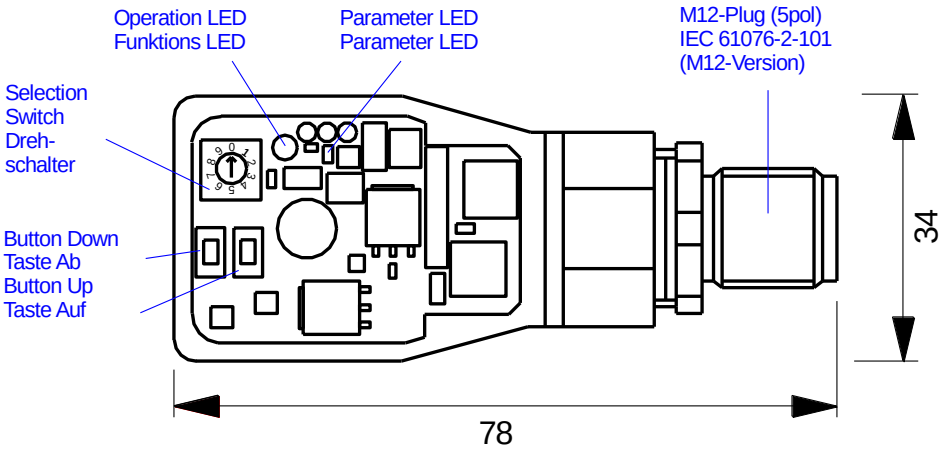
By the free parameterization of the power plug all typical proportional valves of the different manufactures can be optimal adapted.

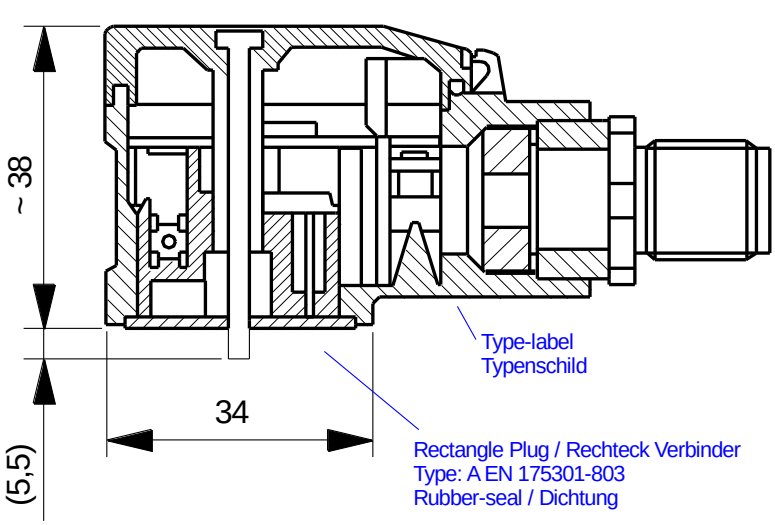
Typical applications: Controlling of the solenoid of proportional throttle or pressure valves.

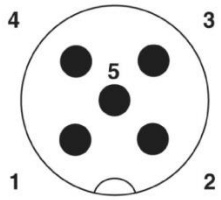
Features

- **Power amplifier for proportional valves located in a DIN EN 175 301-803-A plug housing**
- **Digital reproducible adjustments**
- **Free scaling of the input signal**
- **Also usable as Soft-Switch-amplifier (soft switch-on and switch-off)**
- **M12 connector or cable versions are available**
- **Programmable via USB/LIN bus**
- **Free parameterization of ramps, MIN and MAX, DITHER (frequency, amplitude) and PWM frequency**
- **Parameter settings via integrated buttons and a selector switch (reduced functionally against the USB / LINbus)**
- **Optional: Version with CAN-Bus on request**
- **Output current 1 A / 2,5 A**
- **Adaptable to all standard proportional valves**

2.1 Device description







Pin layout
M12/5 plug

3 Use and application

3.1 Installation instructions

- All cables which lead outside must be screened; complete screening is required. It is also a requirement that no strong electro-magnetic interference sources are installed nearby when using our control and regulation modules.

- The equipment should be installed and wired in accordance with the documentation bearing in mind EMC principles. If other consumers are operated with the same power supply, a star- connected ground wiring scheme is recommended. The following points must be observed when wiring:
    - Analogue signal cables must be screened.
    - All other cables must be screened if there are powerful interference sources (frequency converters, power contactors) and cable lengths > 3m. Inexpensive SMD ferrites can be used with high-frequency radiation.
    - The screening should be connected to PE (PE terminal) as close to the equipment as possible. The local requirements for screening must be taken into account in all cases. The screening should be connected to at both ends. Equipotential bonding must be provided where there are differences between the connected electrical components.
    - With longer lengths of cable (>10 m) the diameters and screening measures should be checked by specialists (e.g. for possible interference, noise sources and voltage drop). Particular care is required with cables of over 40 m in length – the manufacturer should be consulted if necessary.

- A low-resistance connection between PE and the mounting rail should be provided. Transient interference is transmitted from the equipment directly to the mounting rail and from there to the local earth.

- Power should be supplied by a regulated power supply unit (typically a PELV system complying with IEC364-4-4, secure low voltage). The low internal resistance of regulated power supplies gives better interference voltage dissipation, which improves the signal quality of high-resolution sensors in particular. Switched inductances (relays and valve coils connected to the same power supply) must always be provided with appropriate overvoltage protection directly at the coil.

3.2 Commissioning

Step	Task
Installation	Install the device in accordance with the circuit diagram. Ensure it is wired correctly and that the signals are well shielded.
Switching on for the first time	Ensure that no unwanted movement is possible in the drive (e.g. switch off the hydraulics). Check the input current consumption. If it is higher than specified there is an error in the wiring. Switch the device off immediately and check the wiring.
Setting up communication (for parameterization with the WPC-300)	Once the power input is correct the PC (notebook) should be connected via the USB interface and the programming device ULA-310. Please see the WPC-300 program documentation for how to set up communication. **Caution:** The communication works in a HALF DUPLEX process. Further commissioning and diagnosis are supported by the operating software. Alternatively, the set-up can be done by the internal parameter selector and the UP and DOWN buttons.
Pre-parameterization	Set up the following parameters (with reference to the data of the solenoid): CURRENT, MAX and PWM frequency.
Control signal	Check the input signal with a voltmeter. **CAUTION!** You can monitor the current of the solenoids and the input signal alternatively in the WPC-300 program (together with the ULA-310 interface).
Switching on the hydraulics	The hydraulics can now be switched on.
Optimize adjustment	Now optimize the adjustments like RAMP times, MIN and MAX.

3.3 Manual parameterization

The manual adjustment is comparable with the adjustment via potentiometer. Not all parameter of the power plug are available in this mode[2].

The following parameters can be set:

Parameter Switch	Parameter	Setting range	Remark
0	DEFAULT	-	Released only by pressing the button "Up" and "DOWN" simultaneously. Response: a short and fast flashing of the LED.
1	CURRENT	0 | 1	0 = low current range; press „Button DOWN“ 1 = high current range; press „Button UP“
2	MIN	0…60%	Overlap (deadband) compensation In relation to the current range
3	MAX	30…100%	Reduction in the maximum current In relation to the current range
4	R:UP	50ms…5sec	Ramp-up time
5	R:DOWN	50ms…5sec	Ramp-down time
6	PWM	60…1500 Hz	PWM output frequency
7	-		No function
8	-		No function
9	-		No function

For setting the selector switch a screw driver (maximum size: 2.4 x 0.5 mm) is required.

3.3.1 Operation mode for manual adjustment

1. Press a button or turn the selector switch which activates the manual adjustment mode. The parameter-LED flashes.

2. Select the desired parameter (1… 6) by the selector switch.

3. The parameter LED indicates - by flashing - the parameter mode.
   a. At the lower boundary the LED lights only briefly
   b. At the upper boundary the LED lights almost continuously

4. Press the UP or DOWN button.
   a. A short activation of one of the buttons will change the parameter by a value of app. 1%.
   b. A continual activation of one of the buttons will change the parameter continually (up to the point where the upper or lower boundary is reached).

5. The parameters are stored automatically (app. 1 second after the last parameter adjustment). The manual adjustment will be finished after 60 seconds.

[2] The full functionality of the power plug is available via the PC interface only.

4 Technical description

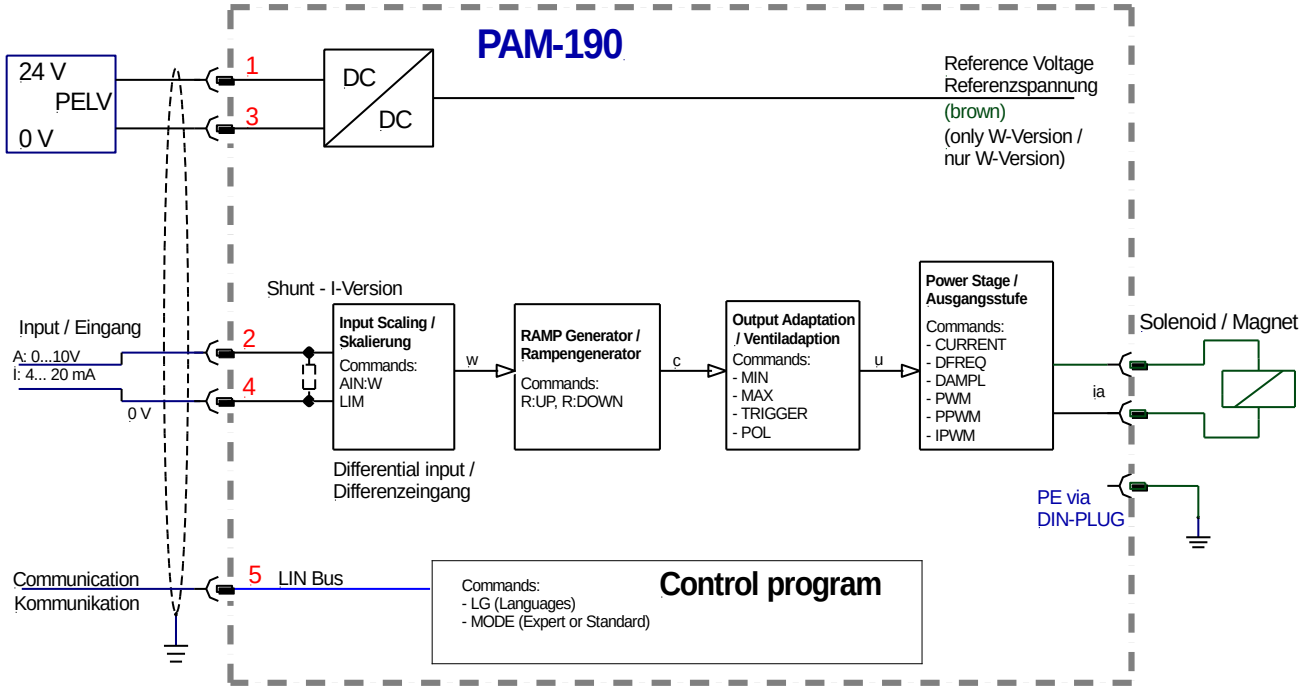
4.1 Input and output signals

Connection	Supply
PIN 1	Power supply (see technical data)
PIN 3	0 V (GND) Power supply (ground).
Connection	**Analogue signals**
PIN 2 PIN 4	Input value (differential input), 0…100% corresponds to 0…10V or 4…20mA.
Connection	**Communication**
PIN 5	**LIN bus connection:** The amplifier is parameterized via this connection and our programming box **ULA-310**.

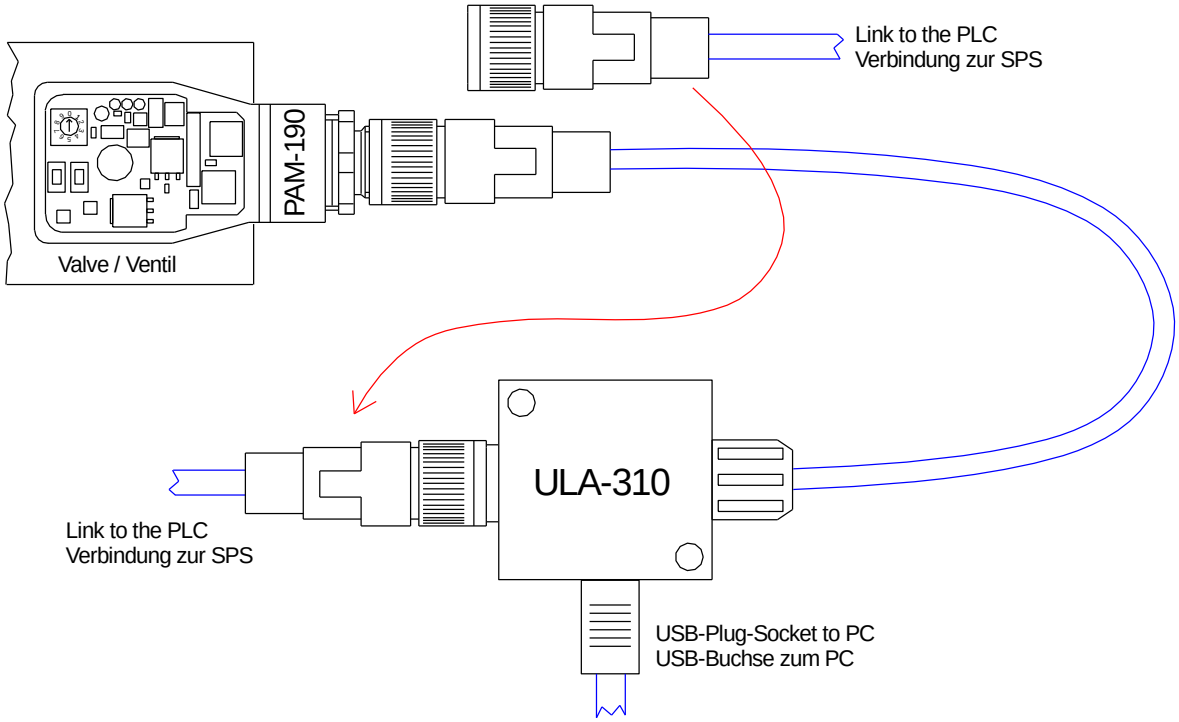
4.2 LED definitions

LEDs	Description of the LED function
FUNCTION LED (yellow)	OFF: no power supply ON: System is ready for operation Flashing: Error detected: Only active when SENS = ON
PARAMETER LED (yellow)	Active in manual mode only.

4.3 Circuit diagram



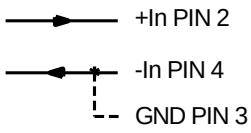
4.4 Typical wiring



Power plug amplifier plus programming device

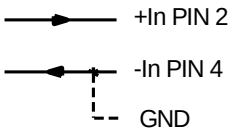
4.5 Analogue input wiring

SPS / PLC 0... 10 V



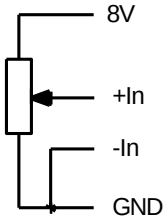
AIN:W 1000 1000 0 V (für 0... 100%)

4... 20 mA input



AIN:W 2000 1600 2000 C (für 0... 100%)

Potentiometer (W-Version)



AIN:W 1000 800 0 V (für 0... 100%)

The cable cross-section should be 0,52 mm² (AWG20) for cables shorter than 3 m. The W-Version has a cable of 3 m and this cross-section. If the cable is lengthened a cross-section of 1.5 mm² (up to 30 m) is to be used.

4.6 Technical data

Power supply Current consumption External fuse	**[VDC]** **[mA]** **[A]**	12… 30 (incl. ripple) < 50 + solenoid current 3 medium time lag
Reference voltages	**[V]**	8 (maximum 10 mA) in W-version
Analogue inputs (sensor and command signals) Resolution	**[V]** **[mA]** **[%]**	0… 10; 90 kOhm 4...20; 240 Ohm < 0,1 (intern 0,02) incl. oversampling
PWM Output current PWM frequency	**[A]** **[Hz]**	1 or 2,5 (per software selectable) 60...2500
Sample time (pressure control) Sample time (solenoid current control)	**[ms]** **[ms]**	1 0,167
Interface		LIN bus, 19200 Baud,
Housing		Hirschmann GDME DIN EN 175 301-803-A
Protection class Temperature range Storage temperature	 **[°C]** **[°C]**	IP65 (with gasket) -20… 65 (consider the current range) -20 …70
Connections		M12, 5-pole (DESINA standard)
Weight	**[kg]**	0,110
EMC		EN 61000-6-2: 8/2002 EN 61000-6-3: 6/2005

5 Parameters

5.1 Parameter list

Command	Default	Unit	Description
LG	EN	-	Changing language help texts.
MODE	STD	-	Mode parameter (standard or expert).
AIN:I A B C X	 1000 1000 0 V	-	Free scaling of the analogue input signal. **Caution:** V|C (Current / Pressure switchover is deactivated)
LIM	0	0.01%	Signal overview function**.**
R:UP	100	ms	Ramp UP time for 100% of the input signal
R:DOWN	100	ms	Ramp DOWN time for 100% of the input signal
MIN	0	0.01%	Zero point setting, deadband compensation.
MAX	10000	0.01%	Maximum output signal limitation.
TRIGGER	200	0.01%	Trigger threshold for activating the following error compensation (**MIN**).
POL	+	-	Reversal of output polarity.
CURRENT	0	-	Output current range: 0= 1,0 A / 1 = 2,5 A
DAMPL	0	0.01%	Dither amplitude.
DFREQ	120	HZ	Dither frequency.
PWM	488	HZ	PWM frequency
PPWM	1	-	Current control loop PI control dynamics.
IPWM	40	-	Current control loop PI control dynamics.

5.2 Parameter description

5.2.1 LG (Changing the language for the help information)

Command	Parameters	Unit	Group
LG x	x= DE|EN	-	**STD**

Either German or English can be selected for the help texts.

CAUTION: After changing the language press the ID button in the speed menu (module identification).

5.2.2 MODE (Switching between parameter groups)

Command	Parameters	Unit	Group
MODE x	x= STD|EXP	-	**STD**

This command changes the operating mode. Various commands (defined via STD/EXP) are blanked out in Standard Mode. The commands in Expert Mode have a more significant influence on system behavior and should accordingly be changed with care.

5.2.3 AIN (Analogue input scaling)

Command	Parameters	Unit	Group
AIN:I A B C X	i= A a= -10000… 10000 b= -10000… 10000 c= -500… 10000 x= V|C	 - - 0.01% -	**STD**

This command can be used to scale the individual inputs. The following linear equation is used for scaling.

$$y = \frac{a}{b} \cdot (x_{input} - c)$$

The "***c" value*** is the offset (e.g. to compensate the 4 mA in case of a 4… 20 mA input). The variables ***a*** and ***b*** define the gain factor.

e.g.: 2.345 correspond to: ***a*** = 2345, ***b*** =1000

The internal measuring resistor for measuring the current (4… 20 mA) is activated via the **x** value and the evaluation switched over accordingly.

The X-value is not active in this module. Switching over from current to voltage input is not possible. The modules a delivered as voltage or current input version (A or I Version) and for this reason can only be changed in the scaling.

Typical settings:

Command	Input	Description
AIN:A 1000 1000 0 V	0… 10V	Range: 0… 100% 0… 10V for the activation of one solenoid.
AIN:A 10 8 1000 V or **AIN:A 1000 800 1000 V**	1… 9V	Range: 0… 100% The offset will be preset on 1000 (10% = 1V) and the gain on 1,25 (1… 9V (8V difference) will be expand to 0…100%.
AIN:A 20 16 2000 C	4… 20mA	Range: 0… 100% The offset will be compensated on 20% (4 mA) and the signal (16 mA = 20mA – 4 mA) will be gained to the range of 100% (20 mA).

5.2.4 LIM (Signal monitoring)

Command		Parameters	Unit	Group
LIM	X	x= 0… 2000	0,01%	**EXP**

The signal monitoring is used to check the input signal - after the scaling function - whether the signal is inside of the defined lower/upper area. Usable - for example - to detect a cable break down of joysticks.

Example:

LIM 500 (5% lower/upper limitation)

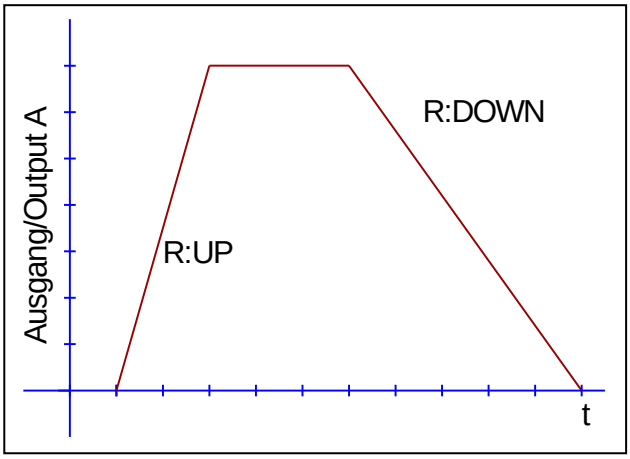
If the input signal is > 95% or < 5% then the signal is outside of the working area. The reason could be a short cut or a cable break down. The power stage will be switched off.

5.2.5 R (ramp times)

Command		Parameters	Unit	Group
R:UP	X	x= 50… 10000	ms	**STD**
R:DOWN	X	x= 50… 10000	ms	

This parameter is specified in ms.

The ramp time is separately set for UP and DOWN.



5.2.6 MIN (Overlap compensation)

5.2.7 MAX (Output limitation)

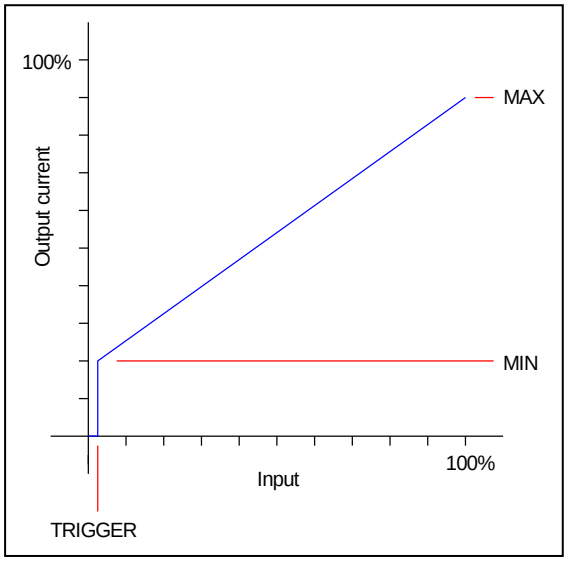
5.2.8 TRIGGER (Response threshold for the MIN parameter)

Command		Parameters	Unit	Group
MIN	**X**	x= 0… 6000	0,01%	**STD**
MAX	**X**	x= 2000… 10000	0,01%	
TRIGGER	**X**	x= 0… 3000	0,01%	

The output signal to the valve is adjusted by means of these commands. With the MAX value the output signal (the maximum valve control) can be reduced. With the MIN value the overlap (dead zone in the valve) can be compensated. Via TRIGGER you define to point, when the MIN adjustment is active.

In this way an insensibility area[3] for the input signal is definable.

CAUTION: If the MIN value is adjusted to high, this will have an effect on the minimum output current (minimum velocity or pressure).



[3] This dead zone is necessary, in order that (with noisy input signal) there will be no unwanted MIN triggering.

5.2.9 POL (Output polarity)

Command	Parameters	Unit	Group
POL X	x= +|-	-	**STD**

The output signal polarity will be reversed.

\+ An input-signal of 0…-100 % leads to an output signal of 0…-100 %
\- An input-signal of 0…-100 % leads to an output signal of 100…-0 %

5.2.10 CURRENT (Current range switchover)

Command	Parameters	Unit	Group
CURRENT X	x= 0|1	-	**STD**

The nominal current range is set with this parameter. Dither and also MIN/MAX always refer to the selected current range.
0 = 1.0 A range and 1 = 2.5 A range.

5.2.11 DAMPL (Dither amplitude)

5.2.12 DFREQ (Dither frequency)

Command	Parameters	Unit	Group
DAMPL X	x= 0… 3000	0.01%	**EXP**
DFREQ X	x= 60… 400	Hz	**EXP**

The dither can be defined with this command. Different amplitudes or frequencies may be required **depending** on the valve.

CAUTION: *The PPWM and IPWM parameters influence the effect of the dither setting. These parameters should not be altered again after the dither has been optimized.*

CAUTION*: If the PWM frequency is less than 500 Hz the dither amplitude DAMPL should be set to zero.*

5.2.13 PWM (PWM frequency)

Command	Parameters	Unit	Group
PWM X	x= 60… 2650	Hz	**STD**

This parameter is entered in Hz. The optimum frequency depends on the valve.

CAUTION: *the PPWM and PPWM parameters should be adjusted with low PWM frequencies[4].*

The PWM frequency can only be set in defined steps. This means that there are deviations between the specified and the actual frequency. The next highest frequency step is always used.

5.2.14 PPWM (Solenoid current controller P element)

5.2.15 IPWM (Solenoid current controller I element)

Command	Parameters	Unit	Group
PPWM X	x= 0… 30	-	**EXP**
IPWM X	x= 1… 100	-	

The PI current controllers for the solenoids are parameterized with these commands.

CAUTION: These parameters should not be changed without appropriate measurement capabilities and experience.

If the PWM frequency is > 2500 Hz the dynamic response of the current controller can be increased.
Typical values are: PPWM = 7… 15 and IPWM = 20… 40.
If the PWM frequency is < 250 Hz the dynamic response of the current controller must be reduced.
Typical values are: PPWM = 1… 3 and IPWM = 40… 80.

[4] Due to the longer dead times at low PWM frequencies the stability of the control circuit is reduced. Typical values are then: PPWM = 1… 3 and IPWM = 40… 70.

5.2.16 **PROCESS DATA (Monitoring)**

Command	Parameters	Unit
W	Demand value (according to the input scaling)	%
C	Demand value (according to the profile generator)	%
U	Control signal	%
IA	Solenoid current A	mA

The process data are the variables which can be continuously observed on the monitor or on the oscilloscope.

6 Appendix

6.1 Failure monitoring

Following possible error sources are monitored continuously:

Source	Fault	Characteristic
Demand value input at 4...20mA	Broken wire	The power stage is deactivated.
Demand value input with the LIM signal monitoring (e.g. for joy-sticks	Out of range	The power stage is deactivated.
Solenoid	Broken wire, short circuit	The power stage is deactivated.
EEPROM (at switching on)	Data error	The power stage is deactivated.

6.2 Troubleshooting

It is assumed that the device is in an operable state and there is communication between the equipment and the WPC-300. Furthermore, the valve control parameterization has been set with the assistance of the valve data sheets.

The RC in monitor mode can be used to analyze faults.

CAUTION: All safety aspects must be thoroughly checked when working with the RC (Remote Control) mode. In this mode the equipment is controlled directly and the machine control cannot influence the module.

FAULT	CAUSE / SOLUTION
READY LED is off.	Presumably no power supply is present. If there is no power supply there is also no communication via our operating program. If a connection has been made to the WPC-300, then a power supply is also available.
READY LED is flashing.	The flashing READY LED signals that a fault is detected by the equipment. The fault could be: • Solenoid error or no signal at the input, if 4… 20 mA signals • LIM monitored input signals are parameterized. • Internal data error: press the command/SAVE button to delete the data error. The system reloads the DEFAULT data. With the WPC-300 operating program and ULA-310 the fault can be localized directly via the monitor.

7 Notes